Probability Prediction of Tropical Cyclone Landfall Intensity in a Changing Climate

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Tropical cyclones depend on climate. As climate changes, the environmental conditions that influence tropical cyclones are expected to change. Till now, confidently quantifying the magnitude of future changes in TC intensity remains challenging, and predicting the future changes in TC intensity at landfall is even more difficult.

We approach this issue with the development of a new statistical-dynamical downscaling system consisting of a multiple linear regression model for the 12-hour intensity forecast as a deterministic component, and a random error generator as a stochastic component. Similar to the operational Statistical Hurricane Intensity Prediction Scheme (SHIPS), the linear regression model relates the surrounding environment to storm intensity, but with only essential predictors calculated from monthly-mean NCEP and ECMWF reanalysis fields (potential intensity, shear, etc.) and from persistence. The stochastic component can be thought of as representing the component of TC intensification and weakening that is not linearly related to the environmental variables. We find that the deterministic component, the regression model, has skill comparable to operational statistical models (e.g. SHIPS); the stochastic component can further improve the linear regression model to better capture the observed TC intensity distribution.

With this stochastic model, we are working on identifying the most essential environment parameters for projecting the statistics of TC landfall intensity in a changing climate. In this presentation, we will show the probability prediction of global TC landfall intensity from the stochastic model in a current climate. The reliability of the prediction will also be calculated globally, basin-wide, and for a specific location of interest. The sensitivity of landfall intensity probability to the changes in the environmental condition will be studied by both changing the magnitude of predictors artificially (but not arbitrarily) and applying the model in conjunction with global climate model fields.